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Published
With international search report.

(54) Title: REVERSIBLE IMMOBILIZATION OF ARGININE–TAGGED MOIETIES ON A SILICATE SURFACE

(57) Abstract

This invention provides materials and methods for the site specific attachment of virtually any moiety to a layered silicate surface. The methods involve covalently attaching the moiety to an arginine tag; and contacting the arginine tag with the layered silicate (e.g., mica) surface.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/18531

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :G01N 33/543, 33/552, 33/549; C12P 21/06, 21/04
US CL :436/518, 527, 532; 435/69.1, 69.7
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 436/518, 527, 532; 435/69.1, 69.7

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS, MEDLINE, EMBASE, BIOSIS, CAPLUS, PASCAL, JAPIO, EURPATFULL

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X, P	NOCK et al. Reversible, site-specific immobilization of polyarginine-tagged fusion proteins on mica surfaces. FEBS Letters. September 1997, Vol. 414, pages 233-238, see entire document.	1-13
Y	WAGNER et al. Bioreactive self-assembled monolayers on hydrogen-passivated Si (111) as a new class of atomically flat substrates for biological scanning probe microscopy. J. Struct. Biol. July 1997, Vol. 119, pages 189-201, see entire document.	1-13

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)		
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed	"&"	document member of the same patent family

Date of the actual completion of the international search 20 NOVEMBER 1998	Date of mailing of the international search report 23 DEC 1998
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer S. DEVI, Ph.D. Telephone No. (703) 308-0196

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/18531

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	SPUDICH et al. Effect of different surfaces and binding modes on the velocity of a single-headed myosin fragment in the in vitro motility assay. Mol. Biol. Of The Cell. December 1996, Vol. 7, page 35a, see abstract 206.	1-5, 8-10 and 13
Y	SPUDICH. How molecular motors work. Nature. 08 December 1994, Vol. 372, pages 515-518, see entire document.	13
Y	HIRABAYASHI et al. Arginine-tail method, an affinity tag procedure utilizing anhydrotrypsin agarose. J. Chromatogr. 1992, Vol. 597, pages 181-187, see entire document.	1-13
Y	GEKE et al. Ion exchange of cation-terminated poly(ethylene oxide) chains of mica surfaces. J. Colloid. Interface Sci. May 1997, Vol. 189, pages 283-287, see entire document.	1-13
Y	US 5,536,382 A (SUNZERI et al.) 16 July 1996, see entire document.	1-5 and 8-10
Y	US 4,448,715 A (RYAN et al.) 15 May 1984, see entire document.	1-5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/18531

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Please See Extra Sheet.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-13

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

...ional application No.
PCT/US98/18531

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING
This ISA found multiple inventions as follows:

1. This International Search Authority has found 6 inventions claimed in the International Application covered by the claims indicated below:

This application contains the following inventions or Groups of inventions which are not so linked as to form a single inventive concept under PCT Rule 13.1.

Group I, claims 1-13, drawn to a method of attaching a moiety to a layered silicate surface via an arginine tag.
Group II, claims 21-27, drawn to a method of orienting a polypeptide on a layered silicate surface via an arginine tag.
Group III, claims 14-20, drawn to a functionalized layered silicate surface with an arginine tag for the attachment of organic molecules.
Group IV, claims 28-33, drawn to a layered silicate surface bearing anisotropically oriented proteins.
Group V, claims 34-50, drawn to a method of purifying a target molecule comprising contacting the molecule with a layered silicate surface.
Group VI, claims 51-55, drawn to an affinity purification device comprising a vessel filled with a layered silicate.

The inventions listed as Groups I-VI do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons.

The term "special technical features" shall mean those technical features that define a contribution which each of the claimed inventions, considered as a whole, makes over the prior art.

The unifying feature of Groups I-VI appear to be the layered silicate surface with or without an arginine tag. Such a layered silicate (mica) surface is taught by Geke et al. (J. Colloid Interf. Sci. 189: May 1995, 283-287). A layered silicate (mica) surface comprising an arginine tag is suggested by the combined teachings of Geke et al. who disclose a layered silicate surface and Sunzeri et al. (US 5,536,382) or Ryan et al. (US 4,448,715) who teach arginine tags and attachment of such tags to a variety of substances. One of ordinary skill in the art would have found it obvious to have attached Sunzeri's or Ryan's arginine tags on a layered silicated surface or mica as taught by Geke et al. for the purpose of protein immobilization on the mica surface or for functionalizing the layered silicated surface. Since the apparent unifying feature is suggested in the prior art, unity of invention does not exist between Groups I-VI, because the unifying feature is not a special technical feature.

In defining each of the Groups, the apparent unifying feature was set forth and it is clear that the unifying feature of each of Groups I, II, III, IV, V and VI is different and distinct from each other,

and it considers that the International Application does not comply with the requirements of unity of invention (Rules 13.1, 13.2 and 13.3) for the reasons indicated below: